INSTITUTE OF PETROLEUM REVIEW

OL. 7. No. 79. JULY, 1953. Price 1 6d. Annual Subscription: Fifteen Shillings

LUBRICANTS

ECLIPSOL OIL CO. LTD.

ROEBUCK LANE WEST BROMWICH

PHONE:
WEST BROMWICH 0431-2-3-4

GRAMS:
SOLUBLE, WEST BROMWICH

PUBLISHED BY THE INSTITUTE OF PETROLEUM
26, Portland Place, London, W.1. Telephone No. LANgham 2250

Anchor

PREMIUM GRADE

SULPHURIZED OILS

use as

Extreme Pressure Additives

in soluble and straight metal working lubricants
in turbine and transmission oils
in lubricating greases

Anti-Oxidants

Anti-Wear and

Anti-Corrosion Additives

Metal Deactivators

- LOW FREE SULPHUR
- LOW CORROSIVITY
- HIGH EP RATINGS
- MINIMUM ODOUR
- GOOD COLOUR

Anchor range includes a grade for every need

ANCHOR CHEMICAL COMPANY LTD.
Clayton, Manchester, 11 : : Telephone: East 2461-6

INSTITUTE OF PETROLEUM REVIEW

Hon. Editor: F. H. Garner, O.B.E., Ph.D., F.R.I.C.
Hon. Associate Editor: E. B. Evans, M.Sc., Ph.D., F.R.I.C.
Editor: George Sell

No. 79 JULY 1953 Vol. 7

CONTENTS

THE USE OF OIL-BASE MUD IN THE BAHREIN FIELD, BY R. K. SMITH 213
THE AUTOMOBILE AND THE PETROLEUM INDUSTRY, BY E. B. V. POTTER 218
WORLD'S LARGEST FLOATING DRILL 226
KWINANA PROGRESS 228
H.M. CORONATION HONOURS 229
SHELL CHAIRMAN ON WORLD CONDITIONS 230
U.K. PETROLEUM CONSUMPTION 231

THE USE OF OIL-BASE MUD IN THE BAHREIN FIELD

By R. K. SMITH (*Associate Fellow*)

In order to gain more information on reservoir conditions in the Bahrein Field, oil-base mud was used for coring through the main producing horizons at a well recently drilled.

Water base and emulsion muds had been used during the coring of some 30 of the earlier wells. The resulting core analysis data was deemed completely accurate as regards porosity and permeability but the fluid contents so determined were thought to have been affected by water contamination from the drilling fluid even though mud water losses were kept from 2-3 cc (API method).

From a theoretical consideration of the data already collected it was possible to estimate the true interstitial water content of the cores. It was hoped that the results obtained when cores were taken with oil-base mud would confirm these figures.

An oil-base mud is essentially a 2-3 per cent water in oil emulsion which has a very low fluid loss (0 cc API). Such fluid loss as does occur should consist only of oil, the continuous phase of the emulsion.

Preparation of Oil-base Mud

The oil-base mud was prepared in the refinery asphalt plant and its composition was based on that of a commercial oil-base mud consisting of mixing oil (diesel) blown asphalt, sodium chloride, caustic soda, sodium silicate, and tall oil as the active ingredients. Sufficient tall oil was not available for this mix so that a com-

mercial product composed of tall oil, caustic soda, and water was used as substitute.

The mixing oil was required to possess the following properties:—

Gravity	29-40° API.
Flash point	200° F or higher (Cleveland Open Cup)
IBP.	320° F—420° F
FBP.	500° F—650° F
Aniline point	90° F—150° F
Surface tension	Less than 24 dynes cm

The Bahrein diesel oil most closely approximating to these specifications nevertheless had too high an aniline point (due to its low aromatic content) and, as this feature would lead to slow solution of the asphalt, it was therefore blended with a highly aromatic solvent to reduce the aniline point. This solvent has a high sulphur content and is obtained as a distillation residue from the re-running of SO_2 extracted kerosine.

The asphalt used was "hard blown" with oxidization done at 450° F to 550° F and carried to the point where the asphalt had an ASTM ring and ball softening point of at least 225° F. Penetration to be 7 to 20 at 77° F.

It was found by laboratory experiments that the best way to achieve the diesel oil-asphalt blend was to dissolve the asphalt in the aromatic solvent and to add the diesel oil last. This procedure was followed in the large scale preparation.

This basic diesel oil (asphalt blend) was mixed in a tank equipped with an internal mixer, heating coils and a circulating pump. The quantities used were as follows:—

Aromatic solvent	41 brl
Blown asphalt (225° F, R and B)	36 brl
Diesel oil	123 brl
Total blend	200 brl

The blend was allowed to mix overnight at 140° F before transporting 60 brl to the rig for future use as oil-base mud "thinners". The other constituents were added to the remaining blend from an open top drum, via a small pump, to the suction side of the circulating pump. Each chemical was mixed in thoroughly giving adequate time for a complete circulation of the tank before the next was added.

The composition of the oil-base mud is given below:—

Asphalt—diesel oil blend	140 brl.
Salt, solid	160 lb G.
Water, with salt	58 U.S.G.
Tall oil, caustic soda, and water (commercial product)	275 U.S.G.
Sodium silicate (1·38 sp.gr.)	110 U.S.G.

The oil-base mud so prepared was weighted up to 88 lb/cu. ft. at the well. Barytes was used as the weighting material and weighting up was carried out in the hole whilst circulating.

Oil-base Mud Characteristics

The above mix is basically a 2-3 per cent water in oil emulsion which is stabilized by a soap formed from the tall oil, caustic soda, and sodium silicate. The asphalt confers low water loss properties upon the mixture. Viscosity and gel strength control is by sodium silicate for thickening or diesel oil—asphalt blend for thinning. Normally tall oil would be used for thinning but this was not available.

Fresh water has the effect of increasing the viscosity of this type of mud and any excess water should be treated with salt. This results in a decrease in viscosity, which remains higher than before contamination took place.

Oil-base mud was not introduced into the well until the coring depth had been reached. Previous drilling had been with water through the lost circulation zone down to approximately 1500 ft, the first casing point, and high *p*H lime-base mud from there to the coring point. By this means contamination of oil-base mud by "solids" picked up from the formation was minimized.

The oil-base mud initially had good properties in every respect except for a tendency for some barytes to settle out

in the mixing pits and storage tank if not constantly gunned. Accordingly ½ gal/brl of the commercial caustic soda-tall oil product was added, followed by ½ gal/brl of sodium silicate in an attempt to increase the viscosity and gel strength.

The sodium silicate however, after some 4-hr delay, formed a heavy viscous "gel" with the barytes which settled out extremely rapidly in the flow lines and suction pit. This condition was not rectified until after the addition of 1 lb/brl of salt to the mud stream. No explanation can be given as to why the salt proved effective for the water content of the mud was normal.

After this early trouble, however, the mud remained in good condition for the remainder of coring operations. Average mud properties were as follows:—

Weight	92 lb/cu. ft.
Viscosity (Marsh 1500 cc in—1000 cc out)	90—120 sec.
Gel strength (Stormer)	
0 minute	1 gram
10 minute	5 gram
Fluid loss (100 p.s.i. for 1 hour)	0 cc
Filter cake	Trace
% water by vol.	3
Flash point	Over 200 F

During the drilling of this well it was found that the normal pressure over balance, as carried with water-base muds, was not sufficient and for oil-base mud this had to be increased by approximately 50 per cent. On two occasions the well unloaded while cores were being removed from the core barrel, but the well was successfully controlled on each occasion; crude oil contamination was anticipated after these events but as the flash point remained above 200°F at all times very little, if any, contamination actually occurred.

The viscosities (Marsh) of oil-base mud appear to be abnormally high by comparison with those of conventional water-base muds. In practice however an oil-base mud viscosity 80 sec is as pumpable as a water-base mud of 35 sec viscosity. Published information suggests the following is regarded as essentially correct in Marsh funnel viscosity comparison:—

Oil Base	*Water Base*
80 sec	35 sec
160 sec	45 sec
200 sec	50 sec

The viscosity of oil-base mud varies considerably with change in temperature. As can be seen from the graph the rate of decrease of viscosity with rise in temperature is not constant. At 100°F a change of 1°F will mean a difference of 1 second in the Marsh funnel viscosity (1500 cc IN—1000 cc OUT) but at 130°F the viscosity variation per °F is only 0.5 seconds.

No trouble was experienced from "solids" picked up from the formation during coring and such slight increases in weight and viscosity as did occur were easily corrected with small additions of "thinners".

Testing Oil Base Mud

Mud weight and viscosity (Marsh) were determined hourly at the rig and recorded by the drilling crews. Daily samples were taken and tested in the laboratory for Stormer viscosity and gel strength, fluid loss, percentage of water by volume (determined by distillation), and flash point. The fluid loss was at all times 0 cc API, the percentage of water never greater than 5, and the flash point was always above 200°F. Had crude oil contamination occurred at any time the flash point of the mud would certainly have been lowered to well below 200°F. It was of prime importance to check whether contamination had taken place because not only would the properties of the mud have been adversely affected but the fire hazard would have been considerably greater.

A fluid loss test was made using a high temperature-high pressure filter press and this showed that, at 175 psi (the calculated overbalance) and the

reservoir temperature of 145°F, the fluid loss was 1·4 cc in 15 hours. This filtrate was distilled and found to contain no water.

Handling of Oil-base Mud

Oil-base mud requires special handling. This is necessary to reduce expensive mud losses, prevent the addition of excess water, insure rig cleanliness, and guard against fire hazards. Accordingly a drain line was constructed from the pipe racking board to the suction pit, all water lines to the rig floor were blocked off, heavy barytes "pills" were used to ensure a dry job when pulling the pipe. Such spillages as did occur were sprinkled with sand or barytes and subsequently scraped off. Extensive precautions were taken against the danger of sparking from the rig engines, shale shaker, etc. It was not considered necessary to construct shelters to exclude rain water.

In order to handle oil-base mud it is necessary to install some additional specialized equipment at the rig. This includes extra storage tanks for the oil-base mud, oil resistant rubber pump parts and pipe wipers, and larger mesh (12 to 20 gauge) screen for the shale shaker which was also fitted with an explosion-proof electric motor.

Caliper and Electric Logging

When coring had been completed a caliper log was run with oil-base mud still in the hole. This caliper log showed that there had been very little deviation from a perfect "true to gauge" hole.

Electric logs were not run until after the oil-base mud had been displaced with high *p*H lime-base mud. These logs were not entirely normal but there is insufficient data available at present to attempt to adequately explain this feature.

Coring with Oil-base Mud

The rate of coring with oil-base mud proved to be rather less than that normally achieved with water-base muds. Core recovery was average for the core head in use. Table I gives the coring statistics for seven recently drilled wells, the same diamond core head being used at each well.

Cores were easily pumped out of the core barrel using oil-base mud and there were no cases of a "stuck core".

Core Analysis Data

Before the use of oil-base mud all coring had been done using conventional water base or oil emulsion muds and although the water losses of these muds were kept to 2-3 cc API the cores so obtained were thought to have been

TABLE 1

CORING WITH OIL-BASE MUD

Well	Mud in Use	Footage Cored	Hours	Coring Rate Ft/Hr	Core Recovery	% Recovery
	High *p*H					
a	Lime-base	205	63·75	3·22	188·5	92
b	,,	349	82·0	4·26	261·4	75
c	,,	477	123·75	3·86	397·5	83
d	,,	362	89·75	4·04	284	78·5
e	,,	271	63	4·30	199·3	73·5
f	,,	140	39	3·59	67·8	48·5
g	Oil-base	376	120·5	3·12	285·7	76
Core head average	—	2180	581·75	3·75	1684·2	77

contaminated with water lost from the mud. As a result the water content as determined in the analysis could not be taken as the true "in place" water content of the core; a theoretical consideration of these results was necessary in order to estimate the true connate water.

By the use of zero fluid loss oil-base mud it was thought that core flushing would be reduced to a minimum, and such flushing as did occur was not expected to alter the connate water content of the core because oil would be the displacing medium.

Core Analysis Results

The core analysis results obtained by coring with oil-base mud provided the desired information, and proved interesting in as much as the water saturations obtained were found to be approximately the same as those derived from the empirical formulae for the determination of connate water in cores obtained using water-base mud.

Cores taken with oil-base mud were examined under the fluoroscope and in some cases the cores appeared to have been invaded to a depth of about 0·25 inch. The small core samples used for analysis are taken from the centre of the cores and thus these should not have been affected. In some isolated examples however, when the core consisted of a loosely compacted porous sandstone, the core seemed to have been completely flushed with oil-base mud.

Effect of Oil-base Mud on Production

In the light of past experience in the Bahrein field it was not thought that the use of oil-base mud would materially affect production from the main producing horizon which is a limestone formation.

This view is based on an extensive series of tests upon a well which was originally drilled in with crude oil. Formation tests were made at predetermined intervals during the drilling in, and production rates and productivity indices were determined for this series of intervals. The well was then "killed" with water-base mud and liners cemented. Gun perforations were then made in exactly the same intervals as had been tested previously and it was found on test that production had been impaired.

Subsequent acidization of the main limestone formation more than restored the initial production. In the so-called "siltstone" formations, however, which consist generally of sandstones, shaley sandstones, and sandy limestones, initial production was not restored, either before or after acidization.

At the recent well oil-base mud was displaced with high pH lime-base mud prior to electric logging and well completion. The main limestone horizon was acidized and its production is normal.

Conclusion

It is believed that the use of oil-base mud in the recent well proved that this type of mud has a definite specialized place in the coring of certain wells.

After some initial troubles directly attributable to inexperience in handling this type of mud the oil-base mud proved to be quite easy to maintain in good condition. In fact it showed itself to be rather less trouble to maintain than the high *p*H lime-base mud previously used.

The core analysis data that will be accumulated, using oil-base mud, should make possible a more thorough and accurate knowledge of reservoir conditions.

Acknowledgement

The author wishes to thank the management of the Bahrein Petroleum Company for permission to read this paper and also to acknowledge the assistance given him by members of all the departments concerned in this project.

THE AUTOMOBILE AND THE PETROLEUM INDUSTRY*

By E. B. V. POTTER†

In 1910, the Government instituted a tax on motor fuels which raised over £300,000 in the first year; today the tax yields more than 750 times that amount. In order to deliver the rapidly increasing requirements of motor spirit the petroleum industry has developed greatly improved plant for distillation of crude. Shell type stills have been succeeded by pipe stills and, partly in order to meet the demands for lubricants, the modern vacuum pipe still was developed. Because of the rapid development of the automobile the demand for motor fuel soon became disproportionately large in relation to that for products from other parts of the petroleum barrel. It was therefore necessary to bring into industrial use on a large scale the process of hydrocarbon cracking, in order to convert gas oils into petrol. The consumption of gasoline in Britain was doubled between 1920 and 1923, doubled again by 1926, and doubled for the third time by 1935. Over this period the average gasoline yields in crude refining increased from about 26 per cent to as much as 47 per cent.

Spark-ignition and Diesel Engines

The early success of the automobile had been based on the use of the spark-ignition engine which, within its general lines of development, was limited to fuels which could be easily vaporized in combustible proportions with air. The spark-ignition engine, even today is very critical of fuels having an upper boiling range above 200°C. The pattern of the petroleum industry was therefore, and is today, built around a very big demand for gasoline. It has, nevertheless, always been possible to build engines to run on fuels in the gas oil range, but such engines have followed a somewhat different line of development based on compression-ignition as opposed to spark-ignition. The application of the compression-ignition or diesel engine was pursued most energetically in Germany, and its commercial success was made possible chiefly by the improvement of injection equipment.

The diesel engine competes most successfully with spark-ignition engines in the larger sizes for at least two prime reasons. Firstly, the lower fuel costs for diesels are of great importance in the case of heavy vehicles, such as in the public transport field, and secondly, because power-weight ratio for CI engines is better than that for spark-ignition engines as the cylinder size increases. Whereas the speed of the CI engine is limited mainly by the combustion process, spark-ignition engines are limited mainly by wear rate to a certain piston speed. Larger spark-ignition engines tend therefore to be limited to crankshaft speeds comparable with those achieved in CI engines. Since 1928 the number of diesel-engined vehicles in the U.K. has increased rapidly and since 1946 even more rapidly so that today they consume almost 20 per cent of all automotive fuels.

Fig. 1 illustrates the increasing use of British vehicles, except between 1939 and 1945. The diesel vehicles, representing about 3 per cent of the total appear rather insignificant on this graph. Fig. 2 shows the corresponding increase in gasoline consumption in the U.K. and it is significant that diesel fuel now represents something like 20 per cent of automotive fuels.

*Summary of paper read to the London Branch IP, 24 September 1952.

†Esso Development Co. Ltd.

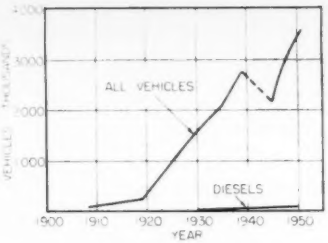


Fig. 1. Increase in number of British motor vehicles during 1908-51.

Fig. 3 shows how automotive fuels have represented a steadily increasing percentage of total petroleum consumption in the United Kingdom, until by 1938 they accounted for 47 per cent by weight. The case of the U.K. is anomalous in that there has been until recently relatively little refining of crude, so that the pattern of product consumption was unconnected with yields from a barrel of crude.

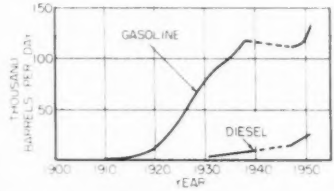


Fig. 2. Consumption of gasoline and diesel fuel in the U.K. during 1910-51.

Fuel Characteristics

It has always been desirable to build IC engines having a high compression ratio, since the higher the compression ratio, the more work a given engine can produce from a gallon of fuel. The practical limit to compression ratio in spark-ignition engines has been the tendency of the fuel to detonate, knock, or pink. The petroleum industry has thus constantly been faced with the problem of improving the antiknock quality, or octane number of its gasoline at the same time as meeting the expanding demand. Since 1939 octane numbers have been increased steadily in the U.K.; they are still increasing in the U.S.A.

The increase in octane number of commercial fuels has made possible over this period considerable increases in compression ratio for spark-ignition engines. The manner in which compression ratio has increased for new

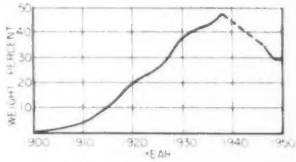


Fig. 3. Percentage increase of automotive fuels to total petroleum consumption during 1900-50.

cars since 1927 is shown by the curve in Fig. 4. This figure also shows the savings in fuel consumption and in engine weight which broadly correspond with these increases of compression ratio. The savings in engine weight have not necessarily all been utilized as such, but they partly contribute to improved road performance. The higher compression ratios of new cars cannot be entirely attributed to improved anti-

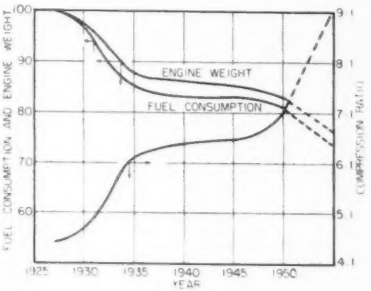


Fig. 4. Increase in compression ratios during 1927-50, and the savings in engine weight and fuel consumption.

knock quality in the fuel; improvements in the design of the engine itself have made possible some increases in compression ratio without requiring fuels of higher octane number. Broadly speaking, however, the improvements made in fuel antiknock quality are responsible for a great deal of the increases in compression ratio of this period.

Among the other properties which have had to be given to motor gasoline are correct volatility characteristics. A well-balanced gasoline contributes a great deal to starting and warm-up performance, and even to the acceleration of the modern car. The fuel must also be delivered into the vehicle tank in a clean condition and must be capable of storage in the tank for long periods without causing corrosion or gum deposits. These properties must be taken care of in refining. Of equal importance to the automobile is the immense system of distribution which has been built up for fuels and lubricants so that there is today no necessity for any vehicle to depart from its route to obtain the correct grades of fuel and oil.

Utilization of Energy in Britain

Table I compares the total energy utilized in the U.K. in 1949 with that used for transport. Petroleum fuels, which are utilized at a thermal efficiency of 25-30 per cent, give better value than coal, which is mainly burned in locomotives at an efficiency of something less than 5 per cent.

This amounts to a big expenditure in moving the population and its commodities about the country. The nett work performed in these operations is by no means apparent unless one considers friction. All the mechanical energy expended in transport, amounting to perhaps 80 million million B.T.U. a year, is dissipated in friction of one kind or another. An appreciable proportion of this energy is required to overcome internal friction within the machines themselves, and it is here that lubrication plays its essential part. Every unit of energy lost in mechanical friction involves the consumption in an automobile of about four times its thermal equivalent in fuel.

The lubrication of automobiles has an additional function beyond that of reducing friction to a practicable level—giving protection from wear and from corrosion. Engine lubrication has had to meet increasingly stringent demands as the automobile has developed. The economic trends of the present day

TABLE I
U.K. ENERGY UTILIZATION (1949)
MILLION MILLION B.T.U.

	Coal & Coke	*Gas*	*Electricity*	*Petroleum*
Total	2,970	252	138	550
Transport	350	—	8	258

demand that machines shall do more work with less attention, so that lubrication must contribute to increased life and reliability. Since 1930, a whole new field has been commercially exploited in the use of additives which have been developed for nearly every aspect of lubrication. It is in the field of motor oils that additives have been mainly successful; they can help in reducing wear and in reducing maintenance costs. Although official statistics for the U.K. are not available, it is estimated that crankcase oils account for about 37 per cent of the total demand for lubricating oil. In addition to the motor oils there are the transmission lubricants and specialized oils, such as those used for hypoid rear axle gears and torque converter transmissions.

In the U.S.A. petroleum products are used in tyres and other rubber components, and the growing petrochemical industry is an important and relatively new source of solvents and plasticizers for coating materials. These

are all aspects of the growing conception of petroleum as a raw material in addition to a fuel.

The automobile today has grown up with the IC engine and with petroleum. Its engine is nevertheless a machine for the conversion of fuel into useful power, and the important question is how much power from how much fuel? The thermal efficiency of most automobile engines is 25-30 per cent—that is, 25-30 per cent of the heat content of the fuel is converted to useful power. In an absolute sense, this figure is low, but it is an excellent efficiency by any current standard of power generation. It compares well, for example, with the efficiency of the best modern electric generating stations, working with a condensing steam cycle, although the automobile is mobile and requires only a fraction of the capital investment per horse power. But so long as the cost of fuel (including tax) averages well over £100 per vehicle per year there will be incentives for improved efficiency.

Spark-ignition Development

The conventional path for the spark-ignition engine is higher compression ratio. It has been shown how compression ratio has increased in the past, and the future trend can be calculated to a limited extent. American manufacturers are exploiting the possibilities of higher compression ratios up to 10 or 12 to 1. There are, however, practical difficulties in raising compression ratios beyond a certain limit. The petroleum industry could raise octane levels of commercial gasoline to, say, 95 (Research) or even to 100, but the cost of each successive octane number is greater than its predecessor, while each additional unit of compression ratio yields a smaller return in economy. Apart from the problem of the conventional knock, some modern American engines of 7½ or 8 to 1 compression ratio are running into pre-ignition troubles. Furthermore, the tendency of spark-ignition engines to knock is greatly aggravated by carbonaceous deposits which form in the combustion chamber, and this problem becomes much more serious with high compression engines. All these problems in the development of IC engines represent a challenge to the petroleum industry in which fuel research is of primary importance.

The spark-ignition engine of the future will certainly use higher compression ratios, although this does not necessarily mean that higher octane numbers will be required. By means of refinements in design it will be possible to increase compression ratio in some degree without octane requirement. Some of the ways in which this can be done are by the extensive use of overhead valves, by improvements in valve and port design to give better breathing, and by more precise distributor design, so that more accurate spark-timing is achieved. Apart from the ignition there is room for improvement in fuel distribution among the cylinders, and petrol injection in some form may provide the answer here. In the petrol injection field the problem becomes one of making the specialized equipment sufficiently precise without its cost being too high compared with that of conventional carburation.

On the mechanical side the latest automobile engines show two interesting trends. Firstly, there is a movement towards increased bore-to-stroke ratio. In the past there has been a tendency towards a long-stroke design because the rate of tax was based on bore only, whereas now bore and stroke may be designed simply for optimum performance. In general, the shorter stroke means reduced piston speed, and the trend is to reduce maximum mean piston speeds from around 2500 ft/min, generally considered the safe maximum, to about 2000 ft/min. These factors tend to reduce the rate of cylinder wear and also to increase engine outputs by cutting down friction losses.

Secondly, the side-valve or L-head design is being abandoned in favour of overhead valves. Overhead-valve design is most favourable for high compression ratios.

Engine Deposits

Today's automobile engine suffers from two defects which together contribute very considerably to its cost of operation: engine deposits and mechanical wear. Engines must be dismantled from time to time from these two causes, and this involves not only the direct cost of stripping and repair, but also the loss of use of the vehicle for a certain period. The use of additive-containing lubricants has in many cases, especially with diesel engines, succeeded in alleviating these effects, but the present situation is far from satisfactory. Until relatively recently the emphasis has been placed on the development of improved lubricants. It has now become very evident, however, that much, if not most, of the blame for engine deposits should lie with the gasoline. Apparently certain commercial fuels contain components which cause deposits not only in the combustion chamber, but on valve gear, on pistons and in the sump.

The reasons for these phenomena are not at present well understood, but there is obviously room for great improvement. It may yet be possible by developments in petroleum technology to enable automobile engines to operate over greatly extended periods without overhaul.

Compression-ignition Development

The CI engine is entering further into the picture. Since fuel cost is contributing (largely owing to taxation) a greater proportion of the total operating cost, the somewhat higher capital and maintenance charges for the diesel engine are more easily justified. The heavy vehicle in future seems likely to change still further from gasoline to diesel. Even in the field of medium-sized passenger cars the German Mercedes-Benz 170-D, for example, with a compression ratio of 19 : 1, is a very reasonable proposition. Something over 25,000 of these cars have been sold since 1945. By the use of improved injection and cylinder head design, future diesel engines are likely to exceed 2000 r.p.m. so that perhaps the cetane number will become a good deal more of a critical requirement than it is at present.

There has recently been experimental work with diesel engines in London taxicabs, and this is clearly a development well worth watching.

Controlled Charge

There is another possible line of development for the piston engine, the so-called knockless design. The principle here is to inject the charge into the cylinder in a controlled manner so as to prevent any possibility of detonation in the unburnt charge. A good example of this design is the Texaco engine. In the conventional spark-ignition engine, after ignition has started at the sparking plug, a flame front travels across the combustion space while pressure and temperature build up rapidly. The last unburnt portions of the charge, the end gas, are subjected to extremely high pressure and tend to detonate spontaneously, producing the knock. With any given fuel the likelihood of detonation is increased as the compression ratio of the engine is raised. In the Texaco engine the air is introduced with a rapid circular swirling motion; the fuel is injected as a fine spray directed towards the sparking plug. In this way each particle of fuel is burnt as it reaches the flame front, while the flame front remains in the vicinity of the sparking plug throughout the combustion process. There is thus no unburnt residue of fuel-air mixture, and so detonation cannot occur. The full

acceptance of such an engine as this could greatly change the pattern of petroleum refining by making antiknock quality in gasoline unnecessary. The design would appear, however, to have all the drawbacks without all the advantages of conventional compression-ignition.

Automotive Gas Turbines

Modern automobile engines are in some ways untidy and inelegant machines having many sliding surfaces and many bearings with an inordinate number of linkages and reciprocating parts. One is tempted, but somewhat unfairly in the technical sense, to draw a comparison with the reciprocating steam engine which has been so generally superseded as a prime mover by the turbine. The automotive gas turbine has yet to be proved in practical use.

It is also interesting to look at the fundamental difference between the reciprocating internal combustion engine in the widest sense and the gas turbine. Both are heat engines in that they take thermal energy from the fuel at a high temperature and perform useful work while rejecting a proportion of that thermal energy at a lower temperature. The efficiency of each engine, looked at in this way, would depend fundamentally upon that high temperature — the higher the more efficient. But the gas in a reciprocating engine undergoes its cycle of changes without leaving the cylinder; in other words, the metal of the cylinder itself undergoes a cyclic temperature change, whereas the gas in a turbine flows through the apparatus as it undergoes its cycle so that the condition of the gas and the temperature of the metal are always the same at any one point. The piston engine can achieve a maximum gas temperature of 4000-5000°F, although no part of the engine need withstand this temperature continuously, whereas the upper temperature for the gas turbine is strictly limited to what the metal parts can continuously withstand —in practice about 1600°F.

This thermal disadvantage of the gas turbine compared with the reciprocating IC engine must, however, be viewed together with its fundamental mechanical superiority. In the gas turbine the energy of combustion is converted directly into rotary shaft power without any reciprocating motion. This factor means greatly simplified construction and reduced engine weight.

Some of the published details of automotive gas turbines under construction or development are shown in Table II. These details merely show that

TABLE II
AUTOMOTIVE GAS TURBINES

Type	*Origin*	*Power Output B.H.P.*	*Specific Fuel Cons. LB/B.H.P.-HR*	*Compression Ratio*	*Heat Exchanger*
Boeing	U.S.A.	175	1·15	2·88:1	No
C.E.T.A.	Spain	170	0·69	4·35:1	Yes
Centrax 1948	U.K.	160	0·70	5·8 :1	No
Laffly	France	180-200	0·90	—	No
Rover T-8	U.K.	185-200	1·20	3·5 :1	No
Rover T-6	U.K.	100	—	—	—
Turbo-méca	France	275-300	0·98	3·6 :1	No
Centrax	U.K.	120	—	—	Yes

there is widespread interest in the automotive gas turbine. In general it looks most promising for powering heavy vehicles. The high specific fuel consumption of the order of 1 to 1·2 lb/hour, which are double the figures for normal gasoline engines, are the result of the temperature limitations previously mentioned, but the development of a successful heat exchanger could solve this problem.

The fuel quality requirements of the automotive gas turbine are at present by no means rigorous. It is desirable that there should be some limit set for sulphur content, viscosity, and calorific

value, but there would at present appear to be no factors which would seriously limit their production from petroleum sources. Antiknock properties would in any case be quite superfluous.

Transmission and Control

Although the power unit of the automobile is of primary importance, especially when seen through oil-tinted spectacles, there are other aspects worthy of consideration. The design of transmissions has recently undergone most extensive developments in the U.S.A. with the use of automatic transmissions in one form or another. Among those which have attracted widespread attention is that which incorporates the hydraulic torque converter. British makers fitted fluid couplings with planetary gear trains many years before world war II, but post-war American developments have advanced several stages in design from the original British self-change gearboxes.

The principle of the torque converter, like the fluid flywheel, involves a pump which imparts energy to the driving fluid whose energy in turn drives a turbine. The torque converter has, in addition, one or more sets of rotating vanes between pump and turbine which are known as stators; the stator modifies the oil flow in order to introduce a degree of torque ratio between pump and turbine. Most of the new American transmission systems comprise some form of combination of the hydraulic torque converter and a planetary gear box, in order to achieve smooth driving performance with a minimum of manual dexterity. The production of these intricate devices on a very large scale with sufficient reliability and cheapness is a remarkable feat of engineering. There are already well over one million passenger cars equipped with torque converters, and about 50 per cent of new U.S. cars possess these transmissions. It has been estimated that, by 1955, 25 per cent of all U.S. passenger cars will have torque converter transmission. They are also used very extensively on buses and coaches.

The advantages of the torque converter are that it will, with a large enough engine, give 100 per cent smooth acceleration from rest to top speed, and can also greatly reduce strain on the driver of the vehicle. There is also a possibility that the freedom from all shocks will increase the life of the remainder of the transmission. On the other hand, its efficiency is poor, especially when operating in the equivalent of low gear, and its range of torque ratios is somewhat limited. If the torque converter is in operation for any appreciable time, therefore, there is considerable loss of fuel economy. Because of its limited range of torque conversion it is much more suitable for automobiles of high power-to-weight ratio. Furthermore, these transmissions are expensive pieces of equipment, especially by British standards. Since in Britain the power-weight ratios of the buses, trucks, and most passenger cars are well below U.S. levels, and since the British attach great importance to fuel economy, torque converter transmissions have limited prospects in Britain. Nevertheless they may well be fitted in the future to passenger cars of the higher power-weight ratios, where they are most attractive, especially in face of American competition in the export market. In spite of all, it seems safe to predict that the British sports car will retain its gear lever as long as it retains its identity.

The torque converter has a reaction on the petroleum industry for not only are the requirements for transmission fluid quite stringent, but its effect will be felt on the fuel side. One of its effects is that the car never has to pull away under load with low engine revolutions; in fact the engine has negligible loading below a speed of

about 1500 r.p.m. From the point of view of antiknock requirements this factor means that the critical knocking range is shifted from low speed to high speed operation. It therefore happens that cars equipped with torque converters tend to rate fuels more according to their motor octane numbers, and less according to their research ratings than do cars fitted with manual gear change. In addition, the absence of high engine loading at low speed largely eliminates bad effects due to maldistribution of TEL between cylinders, so that the full advantage of the lead addition tends to be realized under all conditions with the torque converter.

Another recent and interesting development in the U.S.A. is the use of power-assisted steering in some of the larger models of passenger cars. It is difficult to make any particular predictions for power steering, but taken in conjunction with automatic transmission it can lead to an interesting speculation. Both these developments involve Servo mechanisms, and in the case of the transmission there is also an element of automatic control—almost a mechanical brain. It is interesting to speculate on the further possibilities of automatic control since this field is undergoing very great development. Professor Norbert Wiener has coined the word Cybernetics to embrace the science of control by automatic means. Advances in electronic design have made possible the construction of control devices which will react rapidly to external stimuli, and replace some of the simpler functions of the human brain. It is, therefore, very tempting to speculate in what direction automatic controls may develop with the automobile. Aircraft have for a long time employed the "automatic pilot". In the road vehicle might not such a device, although not altogether replacing the driver, introduce a safety control for use in hazardous driving conditions on what may be the very highly congested roads of the future?

Conclusion

In attempting to keep in focus both the automobile and the petroleum industry, it has been emphasized that the rapid development of the automobile has greatly influenced the pattern of petroleum refining. Tremendous advances have had to be made in both quantity and quality of gasoline production. Today the refining industry is largely built around the big demand for motor gasoline. Britain takes crude from the Middle East containing about 20 per cent gasoline of 50 Research Octane Number and produces from it by refining 30 per cent of gasoline of 70 or 80 Octane Number.

Progress in design must continue. The direction today is towards increased compression ratio in spark-ignition engines, and towards further conversion to diesel engine of heavy vehicles. There is room for great improvements in the field of fuel and lubricant cleanliness. The automotive gas turbine, simple in conception but unproved and relatively undeveloped, is just over the horizon. Petroleum refineries must turn out gasolines of higher octane number and more diesel fuel, while research must overcome the problem of engine deposits. If ever the gas turbine starts to replace spark-ignition engines, the pattern of the refining industry may need to undergo an extensive change. The automobile demands our very best attention.

★ ★ ★

Vacuum's Marketing Expansion—In addition to the new Coventry depot, Vacuum have opened a terminal with a storage capacity of over one million gallons, for the distribution of Mobilgas, Mobilgas Special, and Mobil diesel, to consumers in the north of England. An adjacent warehouse will store a complete range of automotive, industrial, and marine lubricants.

WORLD'S LARGEST FLOATING DRILL

A floating structure four stories high with equipment designed for drilling to 20,000 ft, is now on location in Louisiana waters. Known as the W. M. Keck Sr., the barge was built for The Superior Oil Co. by Levingston Shipbuilding Co. Drilling equipment was supplied by The National Supply Co.

Its power plant totals more than 5000 h.p. Its derrick (Fig. 1) rises 192 ft above the derrick floor; its gin pole is more than 240 ft above the main deck footings.

The barge is designed primarily as an extremely efficient drilling rig that can be moved quickly from one location to another. Consisting of a draw works and related equipment normally considered for drilling in the 16,000 to 20,000 ft depth range, it reached its record-breaking depth of 20,521 ft near Rock Springs, Wyoming. This is the greatest depths to which man has ever penetrated the earth's crust.

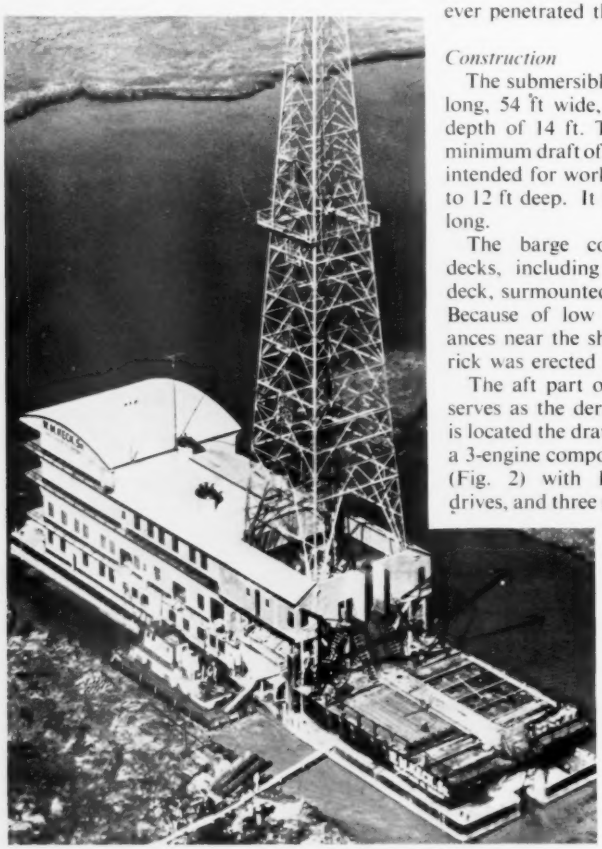


Fig. 1. The W.M. Keck Sr. at work in Louisiana.

Construction

The submersible barge is 237 ft long, 54 ft wide, and has a hull depth of 14 ft. The barge has a minimum draft of 4 ft 6 inches. It is intended for working in water up to 12 ft deep. It has a slot 108 ft long.

The barge consists of four decks, including the barge hull deck, surmounted by the derrick. Because of low overhead clearances near the shipyard, the derrick was erected at the location.

The aft part of the third deck serves as the derrick floor. Here is located the draw works (Fig. 3), a 3-engine compound drive group (Fig. 2) with Ideal-gyrol fluid drives, and three superior PTDS-8 diesel engines.

Equipment

The pump group includes two pumps on the main deck driven from a four-engine drive group on the deck

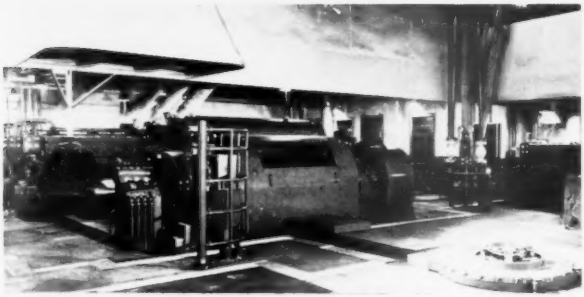


Fig. 3. Part of the spacious derrick floor on the drilling barge.

above. Two deep-well pumps for raw water are also located on this deck.

Nine diesel engines, with a total of 5150 h.p., provide the power for drilling operations. Exclusive of the A.C. electric generating plants, the barge is equipped with three 650-h.p. engines, serving the draw works, the 300-h.p. engine on the standby draw works, the 300-h.p. engine serving the independently driven pump, and the four 650-h.p. engines serving the main battery of pumps.

The mud mixing equipment, including two active mud tanks and a slug tank, which extend from the main deck to the second deck, is also on the second deck, together with all valves for the three mud discharge manifolds, and the remote controls for all pumps and their drive engines, including the gyrols, throttles, and clutches. There are also hoppers for the storage in bulk of mud, up to 4400 sacks.

A sound-proofed generator room on the second deck houses three diesel-driven 100-kW AC generators for the supply of all electrical power requirements, and a diesel-driven arc-welding machine. Distribution of the electrical power is controlled through a very complete and elaborate panel. Other facilities on the second deck include a work shop for repairs.

The hull of the barge houses the charge chambers (slush pump compounding chambers), water-circulating pumps, and fuel-oil pumps.

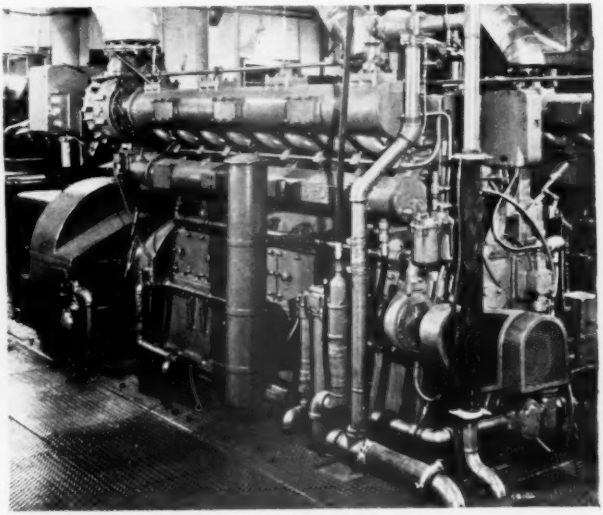


Fig. 2. Part of the 3 - engine compound drive group for the draw works.

KWINANA PROGRESS

Six months almost to the day after work officially started on 1 October 1952 on Anglo-Iranian Oil Company's new refinery at Kwinana, near Fremantle, Western Australia, foundations were being poured for the first permanent refinery structure. This followed a period of intensive site preparation work.

The refinery, which will be the biggest in Australia, will have a throughput of three million tons a year and, when it comes on stream in 1955, is expected to supply the equivalent of about 40 per cent of Australia's petroleum requirements. It will cost £A40 million. Plant will include two atmospheric distillation units complete with stabilizers, solutizers, and soda washers; a vacuum distillation unit; a catalytic cracking unit; a hydrofining unit; and a platforming unit. Two pipelines, one for black, the other for white oils, will link Kwinana with existing installations at Fremantle.

A firm of Dutch dredging contractors, the Hallandse Aanneming Maatschappij, are dredging Parmelia and Success Banks so that tankers will be able to enter Cockburn Sound on which the refinery stands.

As much as possible of the work on the refinery is to be done by Australian firms and Australian workers. Subcontracts let to Western Australian firms for preliminary work on the site so far total £270,000. More than 300 men are employed on these jobs, most of which are ahead of schedule.

Since work began on the 950-acre, scrub-covered site, bull-dozers, graders, and other mechanical equipment have been carving out roads and levelling sites for buildings. Most of the refinery area has been cleared and the four-mile perimeter fenced. About nine miles of permanent roads have been formed and surfacing will be carried out towards the end of the main construction period after consolidation.

A construction camp, complete with mess hall, laundry, and recreation facilities, is ready for occupation by 400 men. Other buildings erected include a warehouse, cement store, offices, workshops, and various small area buildings.

A concrete-batching plant is being erected. When it comes into operation the pouring of foundations will be speeded up. Construction equipment valued at about £1,500,000 will shortly be on the site. The number of workmen will grow steadily to a peak of about 3500 early in 1954. Skilled men and labour are being recruited both in the United Kingdom and Australia.

To provide quick and easy communication between some of the fleet of about 40 marine craft and the shore during the building of the jetties, high frequency radio has been installed. Soon key vehicles and various buildings on the site will be connected by radio with a central headquarters.

Since October 1952 more than 9000 tons of construction material and equipment, and nearly 2000 tons of installation material from the United Kingdom, America, and the eastern states of Australia, have been landed at Fremantle and taken to the refinery site by road. About 75,000 tons of material and equipment will pass through Fremantle before the refinery is completed. Procurement is in the hands of the Kellogg organization.

U.K. Orders

Orders worth more than £6 million have already been placed with British, Australian, and American manufacturers. In the United Kingdom materials costing £3·4 million are on order. Australian orders, which include piping and bar steel, exceed £1,500,000.

l. to r. *R. B. Southall, C.B.E.; the Hon. Frank Hopwood. Kt.; N. A. Gass, C.B.E.; and A. Logan, O.B.E.*

H.M. CORONATION HONOURS

R. B. Southall, director and general manager of National Oil Refineries Ltd. and a vice-president of the Institute of Petroleum, was appointed a Commander of the Most Excellent Order of the British Empire (C.B.E.) in the honours awarded by the Queen on the occasion of Her Majesty's Coronation.

Included in the conferments and appointments are:—

G.C.V.O.

Field-Marshal Viscount Alanbrooke, K.G., G.C.B., O.M., D.S.O., a Government director of Anglo-Iranian Oil Co. Ltd.

Knight Bachelor

The Hon F. J. Hopwood, managing director, Shell Transport and Trading Co. Ltd.

C.B.E.

E. B. Ball, managing director, Glenfield and Kennedy Ltd.

N. A. Gass, M.C., a managing director, Anglo-Iranian Oil Co. Ltd.

O.B.E.

G. R. Armstrong, chief engineer m.v. *Esso Bedford*, Esso Transportation Co. Ltd.

A. Logan, technical manager, Marine Administration, Anglo-Saxon Petroleum Co. Ltd.

J. C. Needham, chairman, Evershed and Vignoles Ltd.

C. M. Spielman, M.C., managing director, Whessoe Ltd.

M.B.E.

E. W. Ashby, chief tanker designer, Joseph L. Thompson and Sons Ltd.

J. W. Strydom, cashier, Vacuum Oil Co. Ltd. (For flood services.)

B.E.M.

F. P. Hudson, maintenance fitter, British Industrial Solvents Ltd.

H. R. Johnson, engineering and maintenance foreman, Whessoe Ltd.

P. McKeever, able seaman, m.v. *Esso Bedford*, Esso Transportation Co. Ltd.

PERSONAL NOTES

Charles J. Porteous has been appointed London sales manager of Brown, Lennox & Co. Ltd. In Venezuela, the Persian Gulf, India, and Trinidad, Mr Porteous gained wide experience in oilfield development construction and bulk oil storage. He has served at the Admiralty and in Brazil. Since 1950 he has been resident engineer of the Regent Oil Co.

Alonzo Limb, managing director of C. C. Wakefield & Co., was recently elected to the additional post of deputy chairman.

A. T. Wright has been appointed a director of The Tanker Insurance Company Ltd.

P. T. Bliss has been appointed sales director of G. A. Harvey & Co. (London) Ltd.

S. T. Baker, technical manager in the Midlands for Vacuum Oil Co. Ltd., has recently retired after 33 years with the company. He is succeeded by **W. H. Depper.**

SHELL CHAIRMAN ON WORLD CONDITIONS

In his report for the year 1952, Sir Frederick Godber, chairman of The "Shell" Transport and Trading Co. Ltd., notes that world consumption of oil products reached a total of 635 million tons, an increase of nearly 7 per cent compared with 10 per cent in 1951 and 12 per cent in 1950.

In 1952 the demand for fuel oil was more greatly affected by economic circumstances than was the demand for any other product. In the U.S.A. fuel oil consumption fell and in the rest of the world the rate of increase was well below that of the previous year.

The construction of new plant and facilities to meet increasing demands for its products has been intensive since the war but in 1952 this construction overtook the rate of increase in demand. This has resulted in a freer supply of oil products and the industry has entered a period of growing competition which, Sir Frederick says "may perhaps be looked upon as a return to normal conditions".

World Production

Accompanying the report is an informative "Survey of Activities of the Shell and Royal Dutch Group of Companies 1952". From this the following details of world production of crude oil and natural gasoline are taken.

WORLD PRODUCTION OF CRUDE OIL AND NATURAL GASOLINE

	1952	1951
	Million brl	
North America		
The United States	2,513·4	2,452·5
Mexico	78·6	78·6
Canada	61·8	48·1
	2,653·8	2,579·2
South America		
Venezuela	661·8	623·4
Colombia	39·5	39·3
Argentina	25·2	24·6
Trinidad	21·4	21·0
Peru	17·7	17·2
Ecuador	3·0	2·8
Others	2·4	2·0
	771·0	730·3
Europe, Middle East and North Africa		
Saudi Arabia	301·9	278·0
Kuwait	273·4	205·1
Iraq	140·8	65·1
Qatar	25·3	18·3
Austria	21·1	14·7
Egypt	16·5	16·4
Western Germany	12·5	9·7
Bahrein	11·0	11·0
Iran	10·0	126·1
Netherlands	5·0	5·0
France	2·6	2·3
Others	3·2	2·2
	823·3	753·9
Far East		
Indonesia	62·0	55·6
British Borneo	38·3	37·5
Japan	2·1	2·3
India	1·9	2·0
New Guinea	1·7	1·8
Others	4·1	3·6
	110·1	102·8
Sub-total	4,358·2	4,166·2
U.S.S.R. and Eastern Europe	382·6	341·4
Grand total	4,740·8	4,507·6

The groups total production, including its share of production in associated companies was 596·7 million barrels (12·6 per cent of total) in 1952, and 549·1 million barrels (12·2 per cent) in 1951.

★ ★ ★

BRITISH PETROLEUM ENGINEERS

In opening an adjournment debate on technological education in the House of Commons on 21 May, J. Johnson, the Member for Rugby, said that recently in Kuwait he had a conversation with an American engineer who hailed from Dallas, Texas, and who said something like this: "You can build jet planes in Britain, but why on earth cannot you send us some technologists to help us in this task of winning oil in the Middle East. Last year your output in the U.K. of petroleum engineers was only five, whereas in the University of Oklahoma alone in the States we turned out something like 300 petroleum engineers."

U.K. PETROLEUM CONSUMPTION

Statistics issued on behalf of the U.K. Petroleum Industry Advisory Committee by the Petroleum Information Bureau show that in 1952 total consumption in the U.K. of all petroleum products amounted to 17,520,145 tons, an increase of 3·7 per cent over the 1951 figure (1951 consumption showed an increase of 10·5 per cent over 1950). The figures cover all petroleum products, whether imported or from indigenous sources, as well as substitutes, such as benzole and hydrogenated spirit.

Slight decreases in consumption over the preceding year are recorded for motor spirit, while industrial spirits, white spirit, gas oil for gas and other manufacture, lubricating oils and greases, paraffin wax, and bitumen, declined to a marked extent. Notable increases are shown for derv fuel and for refinery consumption of fuel oil, a figure which reflects the increased operations in U.K. refineries in 1953.

As shown in Table II, refinery output of finished products in 1952 was 36·7 per cent higher than in 1951. It is noteworthy that output of fuel oil increased by 44·9 per cent, of motor and aviation spirit by 21·9 per cent, and of gas and diesel oil by 17·2 per cent.

In addition to petroleum products, certain indigenous fuels are made available for distribution by the petroleum industry. In 1952 refined benzole totalled 175,493 tons (78,996 tons in 1951) and motor and aviation spirit (by hydrogenation) totalled 108,899 tons (111,862 tons in 1951).

TABLE I

PETROLEUM CONSUMPTION IN THE U.K.

	1951 *Tons*	1952 *Tons*
Motor Spirit*		
Dealers†	3,463,663	3,492,728
Commercial Consumers	1,990,601	1,947,824
Industrial spirits	98,340	78,854
White spirit	149,604	137,394
Kerosine‡	1,435,811	1,443,173
Derv fuel	1,125,623	1,180,440
Gas, diesel and fuel oils:		
Burning	3,237,459	3,245,208
Power	1,170,981	1,216,876
Gas and other manfr.	599,490	506,267
Refinery consumption	871,416	1,256,075
Petroleum industry	121,667	129,843
Lubricating oils and greases	797,172	751,961
Paraffin wax and scale	49,750	30,418
Propane and butane	37,544	48,688
Bitumen	745,647	721,936
Other products	993,140	1,332,460
	16,887,908	17,520,145

*Including motor benzole
†Including industrial benzole
‡Including burning oil and vaporizing oil.

TABLE II

U.K. PRODUCTION OF PETROLEUM PRODUCTS EX IMPORTED AND INDIGENOUS CRUDE AND PROCESS OILS (inc. shale)

	1951 *Tons*	1952 *Tons*
Motor and aviation spirit	2,923,181	4,935,418
Industrial spirits	3,239	2,310
White spirit	51,641	53,046
Burning oil	226,594	568,764
Vaporizing oil	18,507	39,277
Gas diesel oil	3,055,076	3,865,481
Fuel oil	7,649,982	10,097,836
Refinery fuel consumption (ex own production)	852,863	1,240,586
Bitumen	746,227	715,080
Paraffin wax, scale and slack wax	15,117	14,635
Lubricating oil	412,154	369,720
Propane and butane	19,838	24,954
Misc. products and loss	479,233	563,256
	16,453,652	22,490,363

★ ★ ★

The National Industrial Safety Conference was opened by the Mayor of Scarborough on 29 May. Among those present was Dr C. N. Davies, F.Inst.P., a member of the scientific staff of the Medical Research Council, who spoke on "Dust hazards in industry". After stating that the body tended to be more sensitive to poisons breathed into the respiratory tract that it was to dosage by mouth, Dr Davies said that in the past many unsuspected dusts had caused outbreaks ranging from minor skin irritation to lung and systematic damage and even death. Cancer could be caused by operatives inhaling mists or dusts containing certain substances. Dr Davies warned his audience of a new inhalation risk in the shape of radioactive dusts, some of which are harmful in minute concentrations.

LECTURES AND PAPERS

Geochemical Prospecting

An introductory course of lectures and demonstrations of applied geochemical techniques will be given at the Royal School of Mines during the latter part of September, 1953 (probably the week commencing 14 September). The aim of the course is to provide a general background in geochemical prospecting.

The fee for the 7 to 10-day course will not exceed 10 guineas. Enquiries should be addressed as soon as possible to Dr J. S. Webb, Mining Geology Department, Royal School of Mines, London, S.W.7.

The George E. Davis Memorial Lecture

This will be given by Mr Norman Swindin, M.I.Chem.E., in the Reynolds Hall, College of Technology, Manchester, at 3 p.m. on Saturday, 10 October 1953. Further details will be published by The Institution of Chemical Engineers.

The Photogrammetric Society

The following papers, which were presented at the Society's first winter session, will be included in the first two issues of The Photogrammetric Record: *Photogrammetry from high altitude photography; Negative exposure in air photography; A test for systematic error in aerial triangulation; Lens and film resolution;* and *The aspects of photo-geology*. Further details may be obtained from The Honorary Secretary, The Photogrammetric Society, Dept. of Civil & Municipal Engineering, University College London, Gower Street, W.C.1.

* * *

SYNTHETIC DETERGENTS

The Minister of Housing and Local Government has set up a committee "to examine and report on the effects of the increasing use of synthetic detergents and to make any recommendations that seem desirable with particular reference to the functioning of the public health services".

The Constitution of the Committee is:—

Chairman

Sir H. Jephcott (*Glaxo Laboratories Ltd.*)

Members

Dr N. R. Beattie (*Ministry of Health*)
C. E. Boast, O.B.E., M.C. (*Borough Engineer and Surveyor, Croydon*)
Prof J. C. Cruickshank (*London School of Hygiene & Tropical Medicine*)
G. H. W. Cullinan (*Shell Chemicals Ltd.*)
Lt.-Col. E. F. W. Mackenzie, O.B.E., M.C. (*Metropolitan Water Board*)
G. MacRobbie (*Dept. of Health for Scotland*)
F. D. Morrell (*Unilever Ltd.*)
Dr J. R. Nicholls, C.B.E. (*Deputy Government Chemist*)
F. T. K. Pentelow (*Ministry of Agriculture & Fisheries*)
Dr B. A. Southgate (*DSIR*)
H. Symon, C.B. (*Ministry of Housing*)
W. L. Thomas (*Woolcombers Ltd.*)
C. B. Townend, C.B.E. (*Middlesex County Council*)
R. C. Wood (*Thomas Hedley & Co. Ltd.*)

Technical Officers

Dr E. A. B. Birse (*Dept. of Health for Scotland*)
Lt.-Col. F. G. Hill, C.B.E., M.C. (*Ministry of Housing*)
Dr A. Key (*Ministry of Housing*)

* * *

EXPLORATION IN ENGLAND

D'Arcy Exploration Co., Anglo-Iranian's subsidiary, has received a prospecting licence for an area of 114 sq miles to the east of Sleaford, Lincolnshire. The licence has been taken as the result of geophysical work carried out in the area some time ago.

The Company has started drilling a 3500 ft exploratory well at Screveton, Nottinghamshire, where a 136-ft rig is in operation. It is also planned to drill other test wells in the East Midlands, Granby, and Plungar this year.

SAFETY APPLIANCES

At one of Shell's drilling locations in Alberta, Canada, an extremely high concentration (34 per cent) of toxic hydrogen-sulphide threatened the safety of employees. The Safety Representative obtained an artificial respiration instrument and oxygen breathing apparatus and delivered this equipment to the job site. On the day he made the delivery he was able to conduct only a short instructional class on the operation of the instrument. Yet that same night the instrument, called the Pneolator (Fig. 1), was used successfully in reviving members of a contractor's crew who had been overcome by hydrogen-sulphide.

Once the pneolator is put to use no manual assistance is required. It inflates the victim's lungs with the right amount of oxygen at the correct pressure for his specific needs; then it permits exhalation by natural passive return of the patient's respiratory muscles and lungs; then reinflates the lungs with positive pressure. This cycle is repeated continuously in proper rhythm, effectively and safely, until the patient starts to breathe for himself when the instrument automatically becomes an inhalator to supply his oxygen demand. No suction which might harm delicate lung tissue is employed.

Fig. 1. The safety representative demonstrates the Pneolator to employees at Alberta.

Fig. 2. Chemox oxygen breathing apparatus.

The instrument, complete with 21 cu. ft. capacity oxygen cylinder, weighs only 47 lb. Its compactness allows easy transportation over difficult terrain.

Shell is also vitally interested in providing equipment to insure against workers being overcome by toxic gases. But here, again, such equipment must answer the needs peculiar to their operations. They wanted oxygen breathing apparatus which would provide complete protection and yet be light and compact. The Chemox oxygen breathing apparatus (Fig. 2), a self-contained breathing circuit which operates independently of outside air, conforms to these requirements. Worn like a gas mask, the Chemox utilizes a replaceable canister containing a chemical which, upon contact with the moisture in the wearer's exhaled breath, evolves a plentiful supply of oxygen.

OIL COMPANY ORDERS IN THE UNITED KINGDOM

The Oil Companies Materials Secretariat has issued the following statement of the value of orders for materials and equipment placed in the U.K. by oil companies during January to March 1953:—

Geophysical and other exploratory equipment, etc.	4,400
Specialized equipment for oil drilling and production, including oil casing, tubing, etc.	2,571,500
Specialized equipment for oil refineries, etc. (not including pumps and valves)	554,600
Drum and can-making, filling and cleaning equipment, kerbside pumps and other oil metering and dispensing equipment, etc.	232,000
Railcars, road tankers, and aircraft refuellers, etc.	111,200
Drums, drumsheets, and tinplate	1,773,600
Tankage (including tank fittings)	754,800
Tubulars, pipe fittings, and valves (ferrous and non-ferrous)	3,006,000
Pumps (excluding slush, oilwell, and kerbside)	383,400
Boilers, boiler house plant and accessories, etc.	179,200
Electrical equipment—motors, generators, transformers, etc.	1,633,100
Instruments, meters and gauges, etc.	248,100
Prime movers and compressors	593,800
Machine and hand tools, welding and miscellaneous machinery and stores	1,474,900
Ferrous and non-ferrous plates, sections, sheets and bars	717,200
Automotive equipment, all types	1,877,300
Laboratory equipment and chemicals including hospital and medical supplies	216,800
Bulk chemicals, catalysts, barytes, etc.	1,655,700
Cement and other building materials and hardware, including timber	968,400
Commissary, general requisites for office, warehouse, household, club, and sports, etc.	1,159,600
	£20,115,600

The National Supply Co. have issued an illustrated bulletin (No. 383), which describes some of their medium-range drilling equipment. The bulletin also includes engineering specifications in tabular form. Copies may be obtained from the Company's export office at River Plate House, 12, South Place, London, E.C.2.

Venture in Education—This booklet describes how the Royal Dutch/Shell Group of oil companies have attempted to solve the problem of attracting suitable men into the oil industry. Copies are obtainable from The Shell Petroleum Co. Ltd., St. Helen's Court, Great St. Helen's, London, E.C.3.

Colloidal Graphite Ltd. have issued a new brochure dealing with their "Susgra" colloidal graphite products, which are now available in oil-based forms as well as in water dispersions. The brochure also describes some of the manifold uses of colloidal graphite. The Company have acquired a modern factory in the Midlands for the production of bulk requirements to the highest standards.

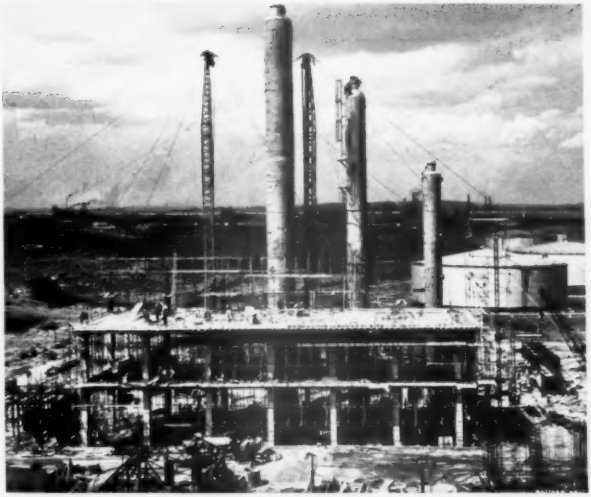
British Patent Specifications. ASLIB have obtained permission to make 35-mm microfilm copies of the Patent Office "Press mark index". This is a 14-year cumulative list of the 271 patent classes, showing, since 1939, the numbers of the patents in each, and their allocation into sub-classes. In most cases this will provide the only subject index at present available The price will be 10 gns. per copy.

New Rope Core—A wire rope, which has a coiled steel spring for a core, is now available. The invention is based on the ability of the coiled spring to withstand flexion and resist crushing. The void within the spring is filled with lubricant, the aim being to prevent friction, rust, and wear of the strands in the rope. The manufacturers, Jones & Laughlin Steel Corpn., claim that the rope is particularly suitable for deep-well, rotary rig drilling.

The National Supply Co., Pittsburgh, Pa., have issued details of a new Ideal power slush pump, which has maximum discharge pressures of 1260, 1535, 1780, 2085, 2480, and 3000 p.s.i. The company have also announced details of two 90-h.p. triplex pumps for water flooding, salt water disposal, oil gathering, cementing, hydraulic pumping systems, and other uses.

ERRATUM

In Personal Notes in the last issue (p. 190), J. A. V. Wilson should read J. A. V. Watson



View of the first British "platforming" unit in course of construction at the Stanlow Refinery, near Ellesmere Port, Cheshire. The estimated cost is £3,500,000, and the plant is due for completion at the end of 1953. The term "platformer" denotes the use of a platinum catalyst to reform low-grade petrol into high-grade petrol.

ALBERTA OIL SANDS

During 1952 exploration permits on eleven 50,000 acre areas were taken out by nine oil companies, and work commenced on a twelfth area, states the 33rd Annual Report of the Research Council of Alberta. The report also contains interesting data on the oil sands and on laboratory studies.

★ ★ ★

THE CHILD ON THE ROAD

This 72-page report to the National Federation of Women's Institutes is based on a study of the experience of road accidents in the U.K. during 1951, when there was the highest recorded total of 42,676 child casualties—at least one child killed or maimed in every 15 minutes.

The members of the study group were Professor J. Harry Jones (Chairman), Miss Enid Blyton, Lieut.-Col. G. T. Bennett, Mr Eric Farmer, Mr G. Prys Williams, and Mr Harold S. Goodwin (Secretary of the Group and Editor of the Report).

The group's task was "to bring to light facts concerning road accidents that can teach practical lessons to all who are concerned with the welfare of children". Thus, the statistical study is in much greater detail than any previous study, official or unofficial, and has involved the scrutiny of 30,000 reports of accidents recorded in the files of the Road Research Laboratory.

★ ★ ★

COMPANY PRODUCTION

	April 1953 *Tons*
Iraq Petroleum Co. Ltd. (Kirkuk)	1,846,459
Basrah Petroleum Co. Ltd. (Zubair)	241,650
Mosul Petroleum Co. Ltd (Ain Zalah)	117,213
Petroleum Development (Qatar) Ltd.	329,543
	May 1953 *Brl.*
Trinidad Petroleum Development Co. Ltd.	283,881
Kern Oil Co. Ltd.	
California	117,306
Trinidad	86,690

★ ★ ★

Honeywell-Brown Ltd. announce the opening of a new branch at 20 Oak Dale Road, Nether Edge, Sheffield 7.

ANGLO-IRANIAN REPORT

In his annual statement to the shareholders regarding operations during 1952, the chairman of the Anglo-Iranian Oil Co. Ltd. gives the Company's crude oil offtake and production from various sources as:—

	1952	1951
	Tons	
Kuwait . .	19,820,000	13,287,000
Iraq . . .	4,295,000	2,316,000
Basrah . .	547,000	—
Qatar . . .	775,000	592,000
Khanaqin . .	492,000	437,000
U.K. . . .	55,400	45,100
	25,984,400	16,677,100

Shale oil production in Scotland was 106,500 tons in 1952, an increase of 2000 tons over 1951.

Refining

Details of refinery throughputs as given in the report are:—

	1952	1951
Great Britain :	*Tons throughput*	
Llandarcy .	4,254,000	3,671,000
Grangemouth	2,375,000	1,512,000
Pumpherston	159,000	—
Belgium :		
Antwerp .	1,718,000	318,000
France:		
Dunkirk –	1,697,000	617,000
Lavera . .	2,061,000	1,814,000
Germany:		
Hamburg .	663,000	620,000
Oelwerke Julius Schindler refinery .	177,000	150,000
Italy, Marghera	1,167,000	687,000
Israel, Haifa .	843,000	—
Kuwait . .	1,272,000	1,157,000
Australia:		
Laverton .	161,000	143,000

Tankers

The British Tanker Co's fleet now numbers 151 ships totalling 1,934,000 dw tons and 27 vessels under construction or on order comprise 12 of 32,000, 12 of 16,000, and 3 of 14,000 dw tons. In addition about 2,000,000 dw tons of tankers are on charter to the Company.

OIL ON TROUBLED WATERS

Members of the oil industry will be interested to see Hollywood's latest version of wildcatting depicted through technicolor-tinted spectacles. This film "Thunder Bay" portrays two oil men, Steve Martin (James Stewart) and Johnny Gambi (Dan Duryea), who arrive at Port Felicity, and induce the president of an oil company to back them in their search for oil below the shallow waters, off the Louisiana coast.

The sea bed is dynamited, piles are driven into it, and a derrick is erected. The two oil men fall in love with two sisters who are daughters of a local fisherman. Here is an oily salad in which are mixed the usual Hollywood ingredients: romance, the prospect of financial ruin, violent conflict with the local inhabitants, a hurricane, and, of course, a gusher.

Entertainment value is above average and the film opens at the *Odeon*, Marble Arch, London, on 2 July, begins its London release on 3 August on the Gaumont British circuit, and will be on general release on 31 August.

SITUATIONS VACANT

MONSANTO CHEMICALS LIMITED require an **Assistant Engineer** for interesting work connected with the Engine Testing of Lubricating Oils. Applicants preferably should have obtained Higher National Certificate in Mechanical Engineering or be a graduate of the Institution of Mechanical Engineers. Experience in this type of work would be an advantage, but is not essential. Salary offered will be according to qualifications and experience. Applications in writing should be sent to Monsanto Chemicals Limited Fulmer Hall Laboratories, Fulmer, nr. Slough, Bucks, giving full details of age, experience, qualifications etc.

MINISTRY OF FUEL AND POWER: OIL GEOLOGIST. The Civil Service Commissioners invite applications from men for this pensionable post. Candidates must have considerable experience in the oil industry on production problems, including the consideration of schemes for the large scale development of oil, and familiarity with the regulations governing oil concessions. A University degree would be an advantage. Inclusive salary £1600 to £1850. Further particulars and application forms from Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1., quoting No. S 4221/53. Application forms to be returned by 30 July, 1953.

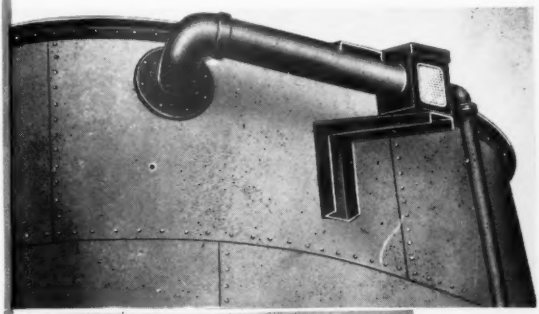
Foamite

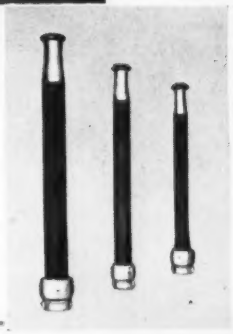
AIRFOAM SYSTEMS

for Refineries

Both fixed and mobile Foamite Airfoam systems are available for the protection of oil storage tank installations and refineries. Fixed system includes around-the-pump or in-line proportioners, airfoam chambers (as illustrated) or in-line foam makers.

The mobile unit carries pump, around-the-pump proportioner, airfoam liquid tank, foam makers, airfoam nozzles, etc. Nozzles are made in 3 light weight models producing 250, 550 or 1,000 galls. of foam per minute respectively, at inlet water pressure of 100 lbs. p.s.i.





FOAMITE LIMITED

235-241, REGENT STREET, LONDON, W.1.

Tel.: REGent 6527/8. Cables: FOAMITE, LONDON.

WORKS: LANGLEY, BUCKS.

Coming of Age

THE MAYFLY spends a year of obscurity in the mud at the bottom of the stream—egg, then larva, then nymph. At last she emerges to the air, a fragile and shimmering adult. She joins the clouds of her fellows for one glorious day, rising and falling, dancing over the stream.

From equally primitive beginnings, the science of lubrication progresses towards perfection. To-day, with the aid of Paramins, oil compounders can anticipate changing requirements and supply lubricants to meet the demands of the most exacting machinery.

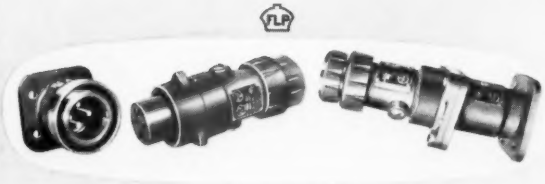
PARAMINS *Paraflow PDX Pour Point Depressant, Paratone Viscosity Index Improver, Paranox Range of Detergent Inhibitors, Paratac Stringiness Agent, Vistone B Oiliness Agent.*

ESSO PETROLEUM COMPANY LIMITED, 36 QUEEN ANNE'S GATE, LONDON, S.W.1

SWITCH AND CONTROL GEAR

• FLAMEPROOF PLUGS & SOCKETS •

100 AMP. 660 VOLT



30 AMP. 660 VOLT

• FLAMEPROOF PLUGS & SOCKETS — 100 AMP. & 30 AMP. RATINGS TO B.S. STANDARDS — RESTRAINED & BOLTED FOR UNSCREENED, SCREENED OR PLIABLE ARMOURED TRAILING CABLES — PLUG COUPLERS — RESTRAINED & BOLTED — 100 AMP. & 30 AMP. ARE ALSO AVAILABLE

CHIEF PRODUCTS

CONTACTOR STARTERS

TOTALLY ENCLOSED
UP TO 450 H.P. AT 660 V.
UP TO 250 H.P. AT 3,300 V.

FLAMEPROOF
UP TO 300 H.P. AT 660 V.
UP TO 250 H.P. AT 3,300 V.

MINING SWITCHGEAR

A COMPREHENSIVE RANGE OF CONTROL GEAR AND ACCESSORIES FOR COAL-CUTTERS, CONVEYORS, LOADERS, DRILLS AND HAULAGE.

OIL-BREAK SWITCHGEAR

TOTALLY ENCLOSED
UP TO 3,000 AMPS. AT 660 V.
UP TO 400 AMPS. AT 3,300 V.

FLAMEPROOF
UP TO 400 AMPS. AT 660 V.
UP TO 400 AMPS. AT 3,300 V.

M.&C. SWITCHGEAR LTD.,
KIRKINTILLOCH, GLASGOW.

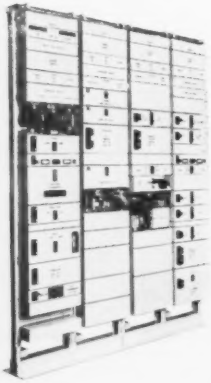
A complete range of

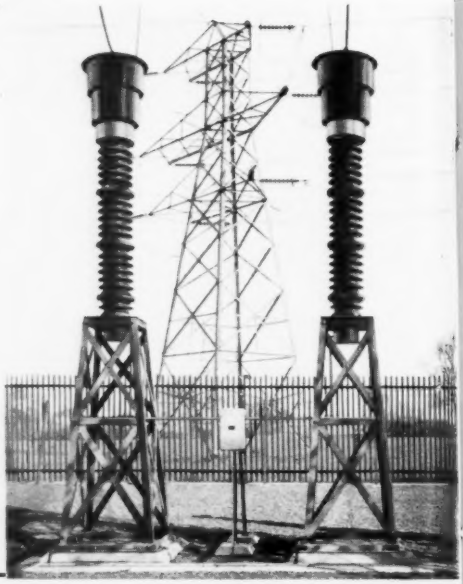
TELECOMMUNICATION

equipment

Line coupling equipment linking power line carrier equipment to E.H.T. lines.

Suite of power line carrier equipment bays.





RELIABLE INDEPENDENT COMMUNICATION WITH NO ADDITION TO LINE COST OR MAINTENANCE

Telephone line rentals or pilot wire costs are avoided by the use of the G.E.C. power line carrier system (Type N) which provides up to ten duplex communication circuits per station over the power lines themselves.

Each circuit in this reliable network accommodates one telephone circuit, one telephone signalling channel (for magneto or dial telephones), and a maximum of six independent channels in each direction for teleprinter working, remote control and indication of switchgear and remote metering.

G.E.C. wide-band line coupling equipment can accommodate feeder protection and high-speed inter-tripping circuits in addition to the ten communication circuits.

consult

G.E.C.

FOR EVERY REQUIREMENT IN TELECOMMUNICATION SERVICE

THE GENERAL ELECTRIC COMPANY, LTD., OF ENGLAND

Telephone, Radio and Television Works :

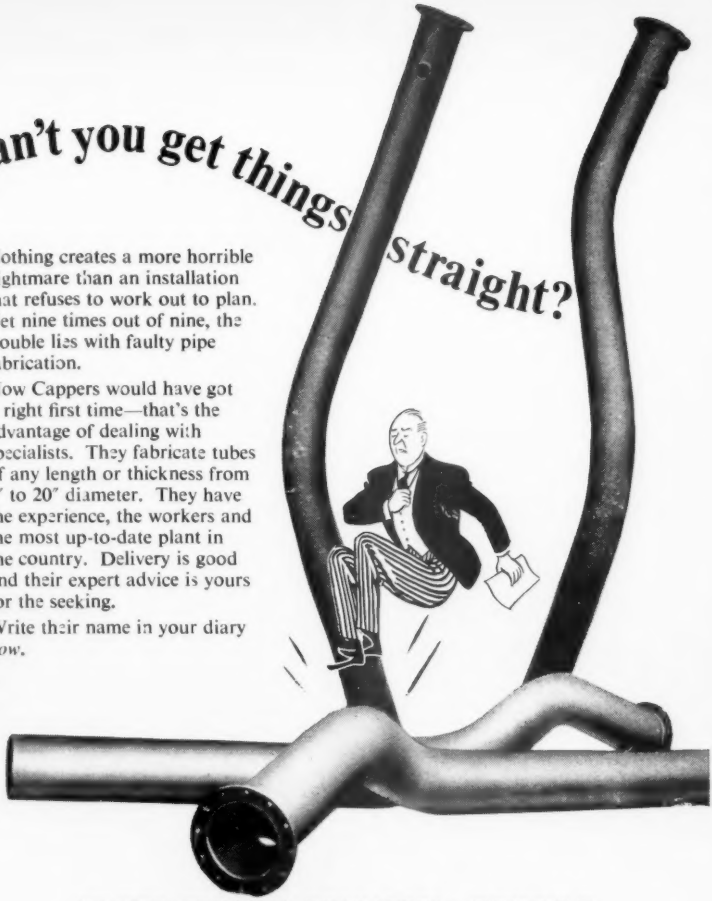
COVENTRY . ENGLAND

Can't you get things straight?

Nothing creates a more horrible nightmare than an installation that refuses to work out to plan. Yet nine times out of nine, the trouble lies with faulty pipe fabrication.

Now Cappers would have got it right first time—that's the advantage of dealing with specialists. They fabricate tubes of any length or thickness from ⅛" to 20" diameter. They have the experience, the workers and the most up-to-date plant in the country. Delivery is good and their expert advice is yours for the seeking.

Write their name in your diary *now*.



IF IT'S TUBE FABRICATION CONSULT

CAPPERS

Please write for our Catalogue No. 3 which gives you full details of our products

WILLIAM H. CAPPER & CO. LTD., FORWARD WORKS, WOOLSTON, WARRINGTON
Telephone: Warrington 3266/7/8
London Offices: 20 SOUTHAMPTON PLACE, W.C.1. *Telephone: CHAncery* 4721

TYLORS' "VISUFLO" METER

combines positive volumetric measure and totalizing with rate of flow indication. Special materials for different types of liquids.

TYLORS OF LONDON LTD

(Established 1777)

BELLE ISLE · YORK WAY · LONDON, N.7

Telegrams: Tylosi', Phone, London *Telephone: North 1625*

SPECIALISTS IN ALL LIQUID METERING PROBLEMS

NICEROL

Speedily and without fail Nicerol Foam KILLS petrol and oil fires—and is used by the Royal Navy, Royal Air Force and Oil Companies specifically for that purpose. Nicerol is a concentrate producing a ***heavy type of vapour-sealing foam*** which flows with creeping flame, blanketing and killing the fire—resisting effectively all possible flash-back or re-ignition. Any type of mechanical or air-foam apparatus will produce foam from Nicerol —either with ***fresh*** or ***salt*** water. Used also by Fire Equipment Manufacturers, Civil Air Lines, Commonwealth and Foreign Governments and Fire Brigades.

Nicerol is supplied in new heavy gauge steel drums specially designed to permit quick release and clean pouring of contents. These are supplied in 2, 5 or 40 Imperial gallons capacity. 3 gallons of Nicerol will produce over 1,100 gallons of pure white foam.

Sample and illustrated leaflet supplied, with quotation, on request

NICEROL LIMITED

GREAT BRICK KILN STREET, WOLVERHAMPTON

Phone: Wolverhampton 24705 *Grams: Nicerol, Wolverhampton*

THE WORD IS INTEGRATION

☆DESIGN

☆PROCUREMENT

☆ERECTION

Badger offers a completely *INTEGRATED* organisation of specialist services guiding and supervising every step from the basic design to the finished **Petroleum** or **Chemical Plant.**

BADGER DESIGNS · BADGER BUILDS

E. B. BADGER & SONS LIMITED

(AFFILIATED WITH STONE & WEBSTER ENGINEERING CORPORATION, BADGER PROCESS DIVISION, U.S.A.)

99 ALDWYCH LONDON W.C.2

Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries

IS YOUR PETROLEUM BOOKSHELF COMPLETE?

It is if it includes ALL the books listed below. Each one is essential to the man who wants to keep abreast of developments and trends in the petroleum industry

- ***Reviews of Petroleum Technology***
  VOLUME 12
  Surveying developments during 1950, this volume brings the wide field of petroleum literature within the covers of one book. Price 50s.
  (A few copies of Volumes 10 and 11 are still available at 27s. 6d. each)

- ***Oil Shale and Cannel Coal***
  Eight hundred pages of the latest data on all aspects of oil from shale. Price 63s.

- ***Electrical Code***
  Covers safety practices in the use of electricity in the field, refinery and storage installation. Price 26s.

- ***ASTM/IP Petroleum Measurement Tables***
  BRITISH EDITION
  Authoritative tables for use in computing oil quantities in territories which employ the British system of weights and measures. Price 50s.

- ***Petroleum Measurement Manual***
  A companion Volume to the "Tables." Essential to anyone who has to deal with the sampling and measurement of liquid petroleum products. Price 25s.

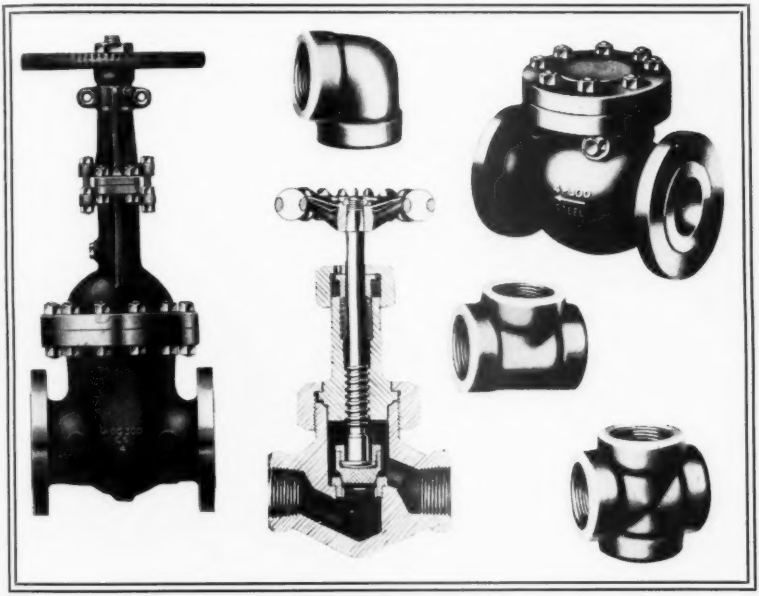
All the above books can be obtained through a bookseller or direct from

THE INSTITUTE OF PETROLEUM

26 PORTLAND PLACE, LONDON, W.1

Our stocks now include Cast steel Gate, Globe and Swing Check Valves

A.S.A. SERIES 150 & 300 also A.P.I. PIPE FITTINGS



BROOKS & WALKER LTD

47 GREAT EASTERN STREET
LONDON, E.C.2

Bishopsgate 7633 Telegrams: Brassiness, Ave, London

Also at

LIVERPOOL · COVENTRY · CARDIFF
DUNDEE · BELFAST · DUBLIN

CRAIG

COMPREHENSIVE SERVICE

*

REFINERY DESIGN AND CONSTRUCTION

•

ATMOSPHERIC AND
VACUUM DISTILLATION UNITS

•

COMBINED DISTILLATION,
CRACKING, REFORMING AND
VAPOUR PHASE TREATING UNITS

•

PARAFFIN WAX EXTRACTION,
REFINING AND MOULDING

•

GASOLINE RECOVERY
AND STABILISATION UNITS

•

HEAT EXCHANGE EQUIPMENT OF ALL TYPES

•

FRACTIONATING COLUMNS
AND TUBE STILLS

A.F. CRAIG & COMPANY LTD

CALEDONIA ENGINEERING WORKS

PAISLEY SCOTLAND

London Office: 727, Salisbury House, London Wall, E.C.2.

Telephone MONARCH 4756

AFC/RP/5

ELECTRICAL EQUIPMENT

by

B
T-H

FOR THE OIL INDUSTRY

From oilfields to refinery, be it heavy generating plant or the smallest of flame-proof motors, BTH is well-placed to meet the electrical needs of this important industry. The technical and manufacturing resources of BTH, backed by over fifty-four years' experience, are a guarantee of the supreme quality of its products. The standard of performance and reputation for reliability are second to none.

for plant of proved performance

· · SPECIFY BTH · ·

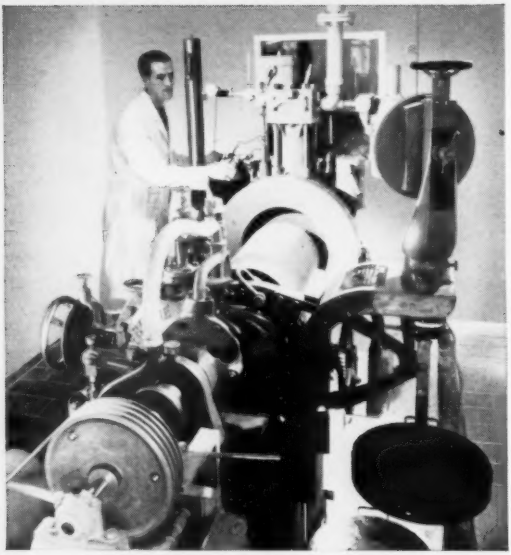
THE

BRITISH THOMSON-HOUSTON

COMPANY LIMITED . RUGBY . ENGLAND

Member of the AEI group of companies

A4183N



A Caterpillar LI-545 test engine at Monsanto Research Station approved for carrying out tests in accordance with U.K. Government specification DEF 2101.

MONSANTO ADDITIVES

at your service

Monsanto is at the service of the oil industry at all times. An essential part of this service is performance testing, under laboratory controlled conditions, of new and improved additives. These tests are carried out at Monsanto's Engine Laboratories at Fulmer, Bucks.

The range of Monsanto oil additives includes:

SANTOPOUR B *Pour point depressant.*

SANTOLUBE 398, 394C *Motor oil inhibitors.*

SANTOLUBE 203B *Motor oil detergent.*

SANTOLUBE 204, 205, 210, 388, 382 *Medium and heavy duty combinations.*

SANTOLUBE AR *Rust inhibitor for turbine oils.*

(SANTOPOUR and SANTOLUBE are Registered Trade Marks)

MONSANTO CHEMICALS LIMITED

Victoria Station House, Victoria Street, London, S.W.1.

In association with:—Monsanto Chemical Company, St. Louis, U.S.A. Monsanto Canada Ltd., Montreal. Monsanto Chemicals (Australia) Ltd., Melbourne. Monsanto Chemicals of India Ltd., Bombay. Representatives in the world's principal cities.

MONSANTO

Richmond Hill Printing Works, Ltd., Bournemouth

PETROLEUM AND TAR TESTING APPARATUS

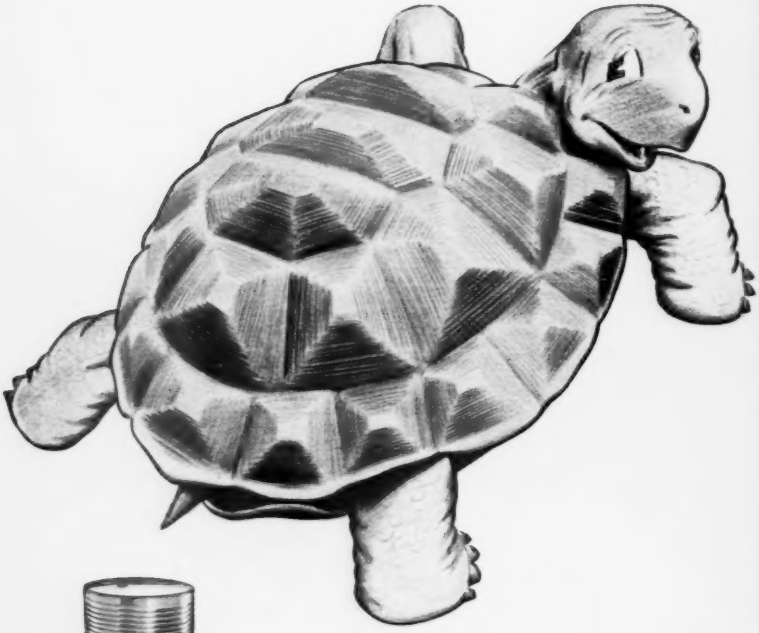
A new Catalogue

is now available

IF YOU ARE INTERESTED PLEASE APPLY FOR A COPY OF CATALOGUE No. 544

A. GALLENKAMP & CO. LTD.
17-29 SUN STREET, LONDON, E.C.2
Telephone: BIShopsgate 0651 (9 lines)
Telegrams: Gallenkamp Ave., London

SAFE IN THE RIGHT CONTAINER



YOUR PRODUCTS ARE PROTECTED BY

METAL CONTAINERS

FOR SAFETY IN TRANSIT

METAL CONTAINERS LTD., 17 WATERLOO PLACE, PALL MALL, LONDON
WORKS: ELLESMERE PORT & RENFREW. ASSOCIATED COMPANIES OVERSEAS
M•W.M

BY

S

ONDON
VERSEA
N·W.1